

Takashi SUGAWARA*: A note on *Heterotropa pseudosavatieri*
and its allied species (Aristolochiaceae)

菅原 敬*: ズソウカンアオイ及びその近縁種について

Heterotropa pseudosavatieri was first described by F. Maekawa in 1932 based on the specimens collected by T. Nakai at Shuzenji, Shizuoka Pref. According to Maekawa (1932), this species was considered to be closely allied to *H. savatieri*, but later he stated that it might be referred to *H. savatieri*. However, *H. pseudosavatieri* has been neglected later by most authors. Sei (1972) suggested that the species had a resemblance to *H. nipponica*. Through the course of my taxonomic studies of *Heterotropa*, I found that *H. pseudosavatieri* and *H. savatieri* were clearly different from each other in flowering season and geographical distribution, though there was no distinct gap between the two species in floral morphology. In this paper, I have intended to re-examine these three species cited above and to make appropriate circumscription of them.

Materials and methods Flowers used in this study were collected from various localities (Fig. 1) and they were fixed with FAA. The flowers were dissected and observed under a binocular microscope, and drawn by using a camera-lucida. In addition, karyological analysis were made with the following procedure. Root tips were pretreated with 0.002 M 8-hydroxyquinoline solution for 4 hr at room temperature and fixed with 45% acetic acid for 25 min. After being macerated in a 1:2 mixture of 45% acetic acid and 1N hydrochloric acid for 20 sec at 60°C, the root tips were stained with 1% acetic orcein solution for one over night. Subsequently, they were squashed with a conventional method. Some of the plants examined are preserved in MAK as dried specimens. The others are now under cultivation in garden of Makino Herbarium.

Observation and discussion Taxonomic characters of *H. pseudosavatieri*.

Morphological features and habit: Leaves of *H. pseudosavatieri* are ovate and cordate at the base. The flower is actinomorphic and composed of three sepals, twelve stamens arranged in two whorls of six each and a gynoecium with six

* Makino Herbarium, Tokyo Metropolitan University, Fukazawa 2-1-1, Setagaya, Tokyo, 158.
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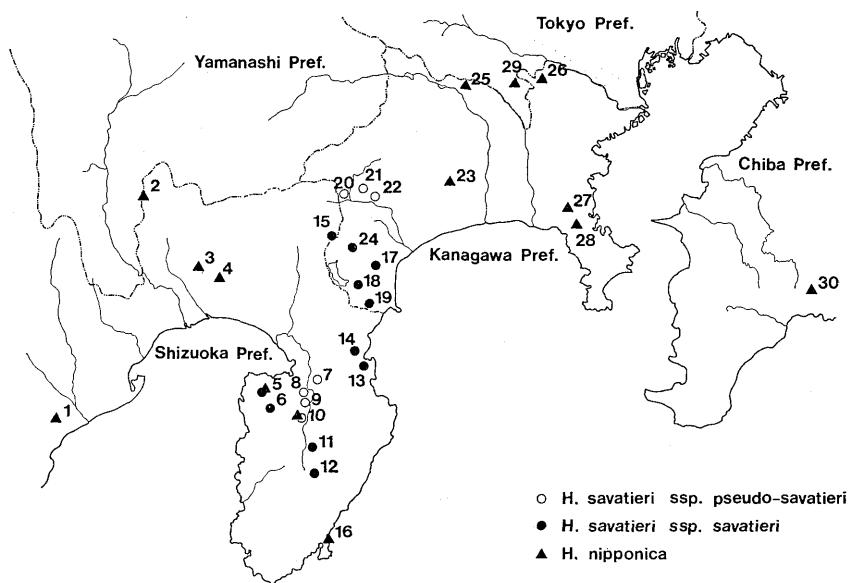


Fig. 1. Localities of the plants examined in this study. 1: Mt. Takakusa. 2: Mt. Chojagadake. 3: Anagahara. 4: Kiwadakubo. 5: Mt. Sanagi. 6: Mt. Daruma-yama. 7: Mifuku. 8: Uriuno. 9: Shuzenji. 10: Aobane. 11: Yoichisaka. 12: Amagi-toge. 13: Ajiro. 14: Kami-tagata. 15: Otome-toge. 16: Sotoura. 17: Yumoto. 18: Hatajuku. 19: Mt. Shiro-yama. 20: Shiozawa. 21: Ichima. 22: Hisari. 23: Mt. Oh-yama. 24: Miyagino. 25: Mt. Ogura. 26: Manpukuji. 27: Kenchoji. 28: Jinmuji. 29: Shinkoji. 30: Mt. Kiyosumi.

styles (Fig. 2A₁). The calyx tube is generally cup-shaped and it is not constricted or slightly constricted at the upper portion. Upper surface of the calyx lobe is smooth, on which unicellulated hairs are found in part (see Fig. 6B). In general, two appendages of the style are completely connate each other, forming a horn-like protuberance (Fig. 2A₂). It is rarely observed in some individuals that two forked appendages of the style are completely divergent each other (Fig. 2B). The reticulation of lamellae on inner surface of the calyx tube is complicated and very variable within this taxon in number of both the longitudinal and transverse lamellae, but it shows a relatively regular lattice pattern (Fig. 5A, B). The longitudinal lamellae extending to the top range from 12 to 18 in number. The ovary is nearly half-superior in position (Fig. 2A₂). The flowers open out in late October to November and the fruits ripen in May to June of the next year.

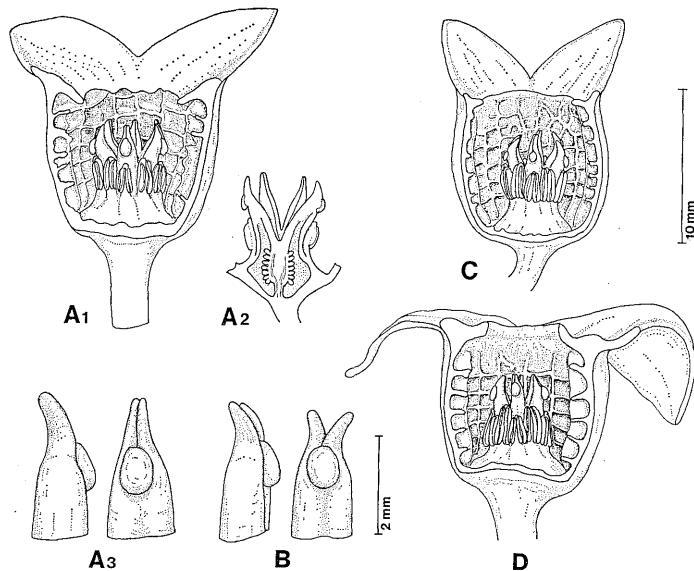


Fig. 2. Flowers. A₁: Flower of *H. savatieri* ssp. *pseudosavatieri*, in which the third part of a calyx tube was removed. A₂: Longitudinal section of a flower of *H. savatieri* ssp. *pseudosavatieri*. A₃: Style with a horn-like protuberance of *H. savatieri* ssp. *pseudosavatieri*. B: Style with two divergent appendages of *H. savatieri* ssp. *pseudosavatieri*. C: Flower of *H. savatieri* ssp. *savatieri*, in which the third part of a calyx tube was removed. D: Flower of *H. nipponica*, in which the third part of a calyx tube was removed.

Cytological features: Being coincident with other species of *Heterotropa* (Ono 1960, Yuasa & Maekawa 1976, Sugawara 1981, 1985), the chromosome number of this species is $2n=24$ in somatic cells. The chromosomal complement is composed of eleven pairs of metacentric chromosomes and one pair of small subtelocentric chromosomes with satellites on the short arms (Fig. 3A). In the karyogram two metacentric pairs, no. 1 and no. 2, are somewhat longer than the rest and occasionally show secondary constrictions on both arms. The subtelocentric SAT-chromosome is the shortest one in its chromosomal complement and thus it is easily distinguished from the other chromosomes. In some individuals from Shuzenji, a difference in size is observed between the homologues in one chromosomal pair (Fig. 3B). In this pair, one chromosome is metacentric and other is submetacentric.



Fig. 3. Serial arrangement of the somatic metaphase chromosomes of *H. savatieri* ($2n=24$). A: ssp. *pseudosavatieri*, collected at Hisari. B: ssp. *pseudosavatieri*, collected at Shuzenji. C: ssp. *savatieri*, collected at Amagi-toge. An arrow points to the submetacentric chromosome. Bar: 5 μ m.

Distribution: In addition to the type locality, Shuzenji, Shizuoka Pref., *H. pseudosavatieri* was found in its neighbouring regions such as Aobane, Uriuno and Mifuku, in the same prefecture. Furthermore, I found new habitats in the upper reaches of Sakawa River; Hisari, Shiozawa and Ichima, Kanagawa Pref. Up to the present, the plants distributed in this region have been identified as *H. nipponica* (Sei 1972), but they seem to be referred to *H. pseudosavatieri*. Recently, Uchida & Koshimizu (1984) reported that the plants distributed in Tanzawa region were slightly different not only from *H. nipponica* but also from *H. savatieri* in floral morphology and growth form, and that these plants were common throughout the western part of Tanzawa region. These plants reported by them seem to agree with *H. pseudosavatieri*. Previously, Maekawa (1932) reported that *H. pseudosavatieri* was also distributed in Hakone, Kanagawa Pref. In the present field research, however, I could not find the plant of *H. pseudosavatieri* in this region where only *H. savatieri* was confirmed to be growing. Although there still remains uncertain as to the detailed distribution, especially in eastern part of Shizuoka Pref., *H. pseudosavatieri* may have a disjunct distribution between Izu Peninsula and Tanzawa district, and also may be isolated geographically from *H. savatieri* which is distributed in Izu Peninsula and Sagami-Hakone districts.

Comparison of *H. pseudosavatieri* and *H. savatieri*. As already mentioned

above, *H. pseudosavatieri* and *H. savatieri* are clearly different in flowering season; the former flowers in late October to November, while the latter in late June to August. Furthermore, these two species have an allopatric distribution each other.

According to Maekawa (1932), *H. pseudosavatieri* and *H. savatieri* were distinguished from each other by shape of the stigma and the style; the former species is characterized by a small globular stigma and a style with two divergent appendages, while the latter has an oval stigma and a style with a horn-like protuberance. From the present observation, however, no difference in shape of the stigma and its size was recognized between these two species. Namely, the shape of the stigma in both species is generally globular or slightly oval (Fig. 4B, C). Although two divergent appendages of the style have been regarded as a characteristic feature in *H. pseudosavatieri*, it is rarely observed in this species (Fig. 2B). In *H. pseudosavatieri* generally, the two appendages of the style are completely connate each other, forming a horn-like protuberance (Fig. 2A), such as those of *H. savatieri* (Fig. 2C). Therefore, this character should be regarded as being of little diagnostic value for distinguishing them.

The pattern of the reticulation on inner surface of the calyx tube in *H. savatieri* is, as a whole, more complex than that of *H. pseudosavatieri* (Fig. 5A, B and D). Namely, in *H. savatieri* the number of the longitudinal lamellae extending to the top is more numerous and the lattice pattern is more irregular. However, the reticulations in some individuals show intermediate patterns between the two groups.

Also in other characters, such as shape of appendages of the style (Fig. 4B, C) and stamen, ovary position, length of filament, hair condition on upper surface of the calyx lobe, leaf shape, chromosome number and karyotype (Fig. 3), no significant difference is recognized between the two groups. However, they are easily distinguished from each other in flowering season and geographical distribution. The difference in flowering season suggests a reproductive isolation between the two species.

As based on the results obtained here, it seems to be valid that *H. pseudosavatieri* and *H. savatieri* are circumscribed together as belonging to the same species, in which the rank of each taxon is treated as subspecies.

Comparison of *H. nipponica* with *H. pseudosavatieri* and *H. savatieri*. These three species are distributed in southern Kanto and Izu Peninsula (Sei 1972,

Ohwi 1975, Uchida & Koshimizu 1984). Their leaves and flowers, as a whole, resemble each other. Also, *H. nipponica* and *H. pseudosavatieri* have the same flowering season. Thus, these three taxa have been often confused with each other.

Up to the present *H. nipponica* has been distinguished from *H. savatieri* mainly by having a cup-shaped calyx tube, inner surface of which has the reticulation with regular lattice pattern, and also by having a shorter protuberance of the style. In this study, however, it was revealed that these characters were very variable and continuous between the two taxa. Therefore, these characters are regarded as being of little diagnostic value for discriminating these two taxa. Figure 4 shows variations of the shape of calyx tube and the length of protuberance of the style in each species. In *H. nipponica*, the calyx tube is mostly cup-shaped and not constricted at the upper portion. However, the calyx tube slightly constricted at the upper portion was observed in some individuals, and the globular calyx tube, which is general in *H. savatieri*, was rarely observed in *H. nipponica*. The length of protuberance of the style was relatively shorter in *H. nipponica*, though the style with a long protuberance was often observed, especially in the specimens from Kiwadakubo and Anagahara, Shizuoka Pref.

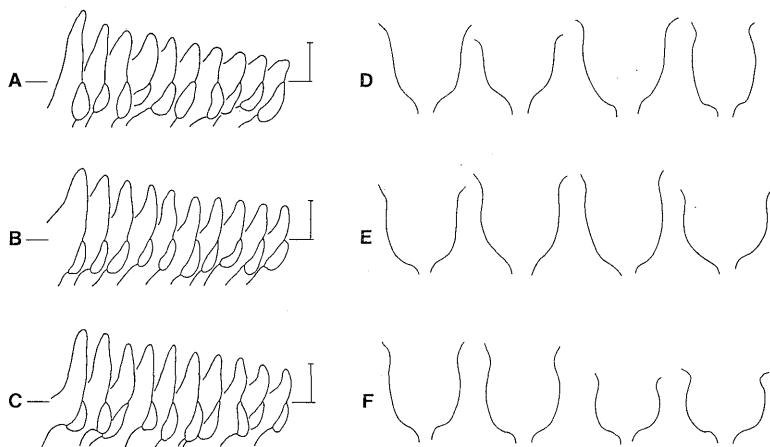


Fig. 4. Variation of the protuberance length of the style and the shape of the calyx tube collected from various localities. A, D: *H. nipponica*. B, E: *H. savatieri* ssp. *pseudosavatieri*. C, F: *H. savatieri* ssp. *savatieri*. Bar: 1 mm.

On the other hand, in *H. savatieri* the length of this protuberance is generally longer, though the shorter protuberances are also observed.

Figure 5 shows the variations of the reticulation on inner surface of the calyx tube in each species. The number of longitudinal lamellae extending to the top ranged from 9 to 12 in *H. nipponica* and 12 to 18 in *H. savatieri*. As a whole, the pattern of reticulations in *H. nipponica* was more simple and more lattice-like than that of *H. savatieri*. However, the variation of this character is continuous through that of *H. pseudosavatieri* (see Fig. 5A, B).

A notable difference between *H. nipponica* on the one hand and *H. savatieri* and *H. pseudosavatieri* on the other is found in hair condition on the upper surface of the calyx lobe; the former is characterized by having multicellular hairs, while the latter has small unicellular hairs (Fig. 6). Furthermore, *H. nipponica* has a thicker calyx tube, three reflexed calyx lobes and an orifice ring slightly raised (see Fig. 2D). As based on these characters, *H. nipponica* seems to be clearly distinguishable from *H. savatieri* and *H. pseudosavatieri*.

According to my observation and discussion presented above, I wish to summarize the taxonomy of these three entities as follows:

***Heterotropa savatieri* (Franchet) F. Maekawa in Journ. Jap. Bot. 9: 241 (1933). *Asarum savatieri* Franchet in Journ. de Bot., 12: 307 (1898)—F. Maekawa in Bot. Mag. Tokyo 46: 581 (1932)—Ohwi, Fl. Jap. 529 (1965).**

ssp. *savatieri*

Nom. Jap. Otome-aoi.

Dist. Izu Peninsula and Hakone district.

This subspecies is characterized by having a flowering season in late June to August.

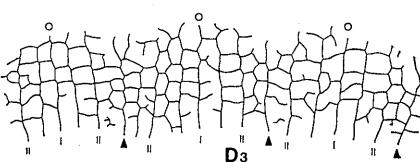
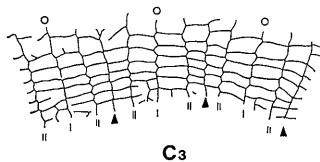
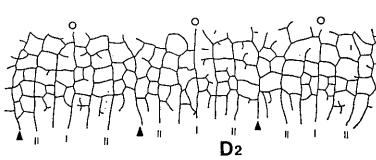
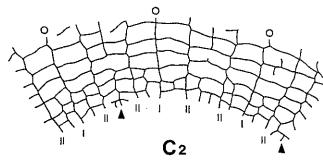
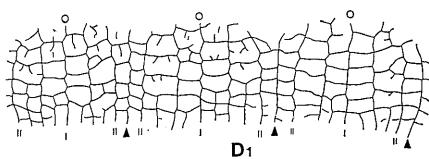
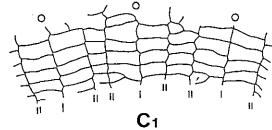
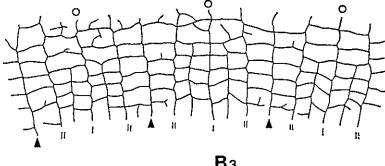
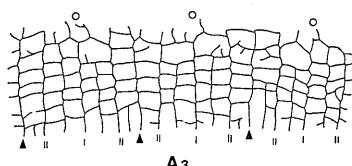
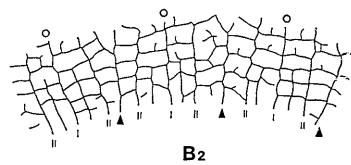
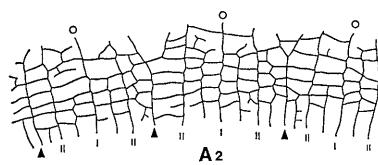
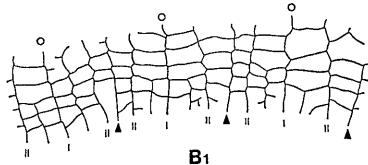
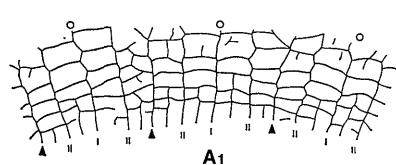
ssp. *pseudosavatieri* (F. Maek.) Sugawara, comb. nov. *Asarum pseudosavatieri* F. Maekawa in Bot. Mag. Tokyo 46: 582 (1932). *Heterotropa pseudosavatieri* (F. Maek.) F. Maekawa in Journ. Jap. Bot. 9: 512 (1933).

Nom. Jap. Zuso-kan-aoi.

Dist. In and around Shuzenji, Izu Peninsula and Tanzawa district.

The flowering season of this subspecies is in late October to November.

Fig. 5. Reticulation of the lamellae on inner surface of the calyx tube. A: *H. savatieri* ssp. *pseudosavatieri* collected at Shuzenji. B: *H. savatieri* ssp. *pseudosavatieri* collected at Ichima. C: *H. nipponica* collected at Kiwadakubo. D: *H. savatieri* ssp. *savatieri* collected at Amagi-toge.



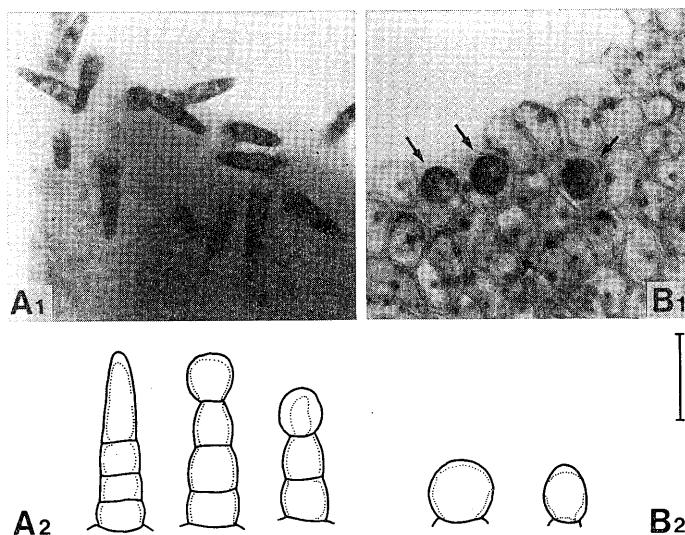


Fig. 6. Hairs on upper surface of the calyx lobe. A: *H. nipponica*, multicellular hairs which cover the upper surface densely. B: *H. savatieri*, unicellular hairs which are scattered sparsely on the upper surface (see arrows). Bar: 50 μm .

Representative specimens: Shuzenji (Nakai, T. Jan. 1926. Type in TI); Shuzenji (Sugawara, T. MAK 197292-197295); Aobane (Sugawara, T. MAK 208830); Uriuo (Sugawara, T. MAK 197288); Mifuku (Sugawara, T. MAK 197284); Hisari (Sugawara, T. MAK 203294); Ichima (Sugawara, T. MAK 208829); Shiozawa (Sugawara, T. MAK 208828); Minasegawa (Uchida, T. MAK 210420); Kayanuma (Uchida, T. MAK 210421).

***Heterotropa nipponica* (F. Meak.) F. Maekawa in Journ Jap. Bot. 9: 44 (1933). *Asarum nipponicum* F. Maekawa in Bot. Mag. Tokyo 46: 570-571 (1932). *Asarum kooyanum* Makino var. *nipponicum* (F. Maek.) Kitamura in Acta Phytotax. Geobot. 20: 207 (1962)—Ohwi in Fl. Jap. 529 (1965).**

Nom. Jap. Kan-aoi.

Dist. Southern part of Kanto district, Izu Peninsula, eastern part of Tokai district and eastern part of Kii Peninsula.

This species is closely allied to *H. savatieri*, but differs from the latter in having multicellular hairs on upper surface of the calyx lobes.

I am grateful to Prof. M. Ono and Assoc. Prof. M. Wakabayashi of Tokyo Metropolitan University, for their kind suggestions during the course of this work, and also for their critical reading of the manuscript. My thanks are also due to Mr. T. Uchida who kindly provided the materials. I wish to express my deep gratitude to the directors of the herbaria of MAK and TI who allowed me to examine the specimens.

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ズソウカンアオイ *Heterotropa pseudosavatieri* は、伊豆半島修善寺の標本に基づいて前川（1932）が記載した種である。しかし一般的には受けいれられていない種である。後に前川自身、この種はオトメアオイ *H. savatieri* (Franchet) F. Maekawa に含まれるものとみなしている。ところが最近の調査で、オトメアオイとズソウカンアオイは花期がはっきり異なることが明らかとなった。そこで、これらの種の分類学的再検討を試みた。その結果、両者の間で、分布域ならびに花期におけるはっきりとした違いが認められるものの、形態的には顕著な質的差異が認められなかった。そこで両者を同一種内の亜種関係にあるものと考えたい。従って、ズソウカンアオイの学名は、*H. savatieri* ssp. *pseudosavatieri* (F. Maek.) Sugawara となる。

なお、近接した地域に分布するカンアオイ（カントウアオイ）との差異についても再

検討した。従来、カンアオイとオトメアオイは、花柱附属突起の長さ、萼筒内壁のひだ紋様を指標形質として区別されている。しかし、これらの形質はかなり変異し、はっきりと種差を指標するほどのものではなかった。両者は、むしろ萼裂片上面の毛にはっきりとした違いを示していた。すなわち、カンアオイの萼裂片上面には、多細胞の短毛が多数みられるが、オトメアオイならびにズソウカンアオイでは、単細胞性の球状の毛がわずかに散在しているのみである。

□Geissler P. & H. Bischler (ed.) : **Index Hepaticarum, vol. 10: Lembidium to Mytilopsis** 352 pp. 1985. J. Cramer, Braunschweig. DM150. これまで、故 C.E.B. Bonner の Index Hepaticarum vols. 1-9 として、属名の A から L (*Lejeunea*) までと *Plagiochila* が発刊されていたが、vol. 10 以降は国際苔類学会 (IAB) のプロジェクトとして、ジュネーブの P. Geissler とパリの H. Bischler が中心となって編集発行することとなった。Bonner の Index とは形式が大幅に変更されている。主要な変更は 1978 ICBN (レニングラード・コード) に基づいて、記録された epithet が illegitimate または invalid な場合には ICBN の条項を各々示してある。また Bonner の Index では type の選定をしている場合が多く、lectotypification とみなされたが、今回からは type の選定は一切行わず、原記載に書かれた通りを再録する形式をとっている (従って lectotypification はない)。従来あった、その type の所在場所の明示もなくなった。今回からは主として東ドイツの R. Grolle, パリの D. Lamy, 日本の服部博士やオランダの S.R. Gradstein がデータの提供やチェックに協力しているほか、多数の苔類学者が各属(91属)を分担して取りまとめを行っている (日本からは S. Hattori, H. Inoue, Y. Kuwahara が分担をうけもっている)。苔類の命名、分類等に關係する人には不可欠の Index である。
(井上 浩)

□Crum H.A. : **North American Flora, ser. II, Part 11, Sphagnopsida • Sphagnaceae** 180 pp. 1984. New York Botanical Garden. ¥10,000. NY が 1954 年から始めた North American Flora 第 2 期プロジェクトでは、すでに Fontinalaceae, Hookeriaceae のセン類が取り上げられていたが、今回、ミズゴケ類が総説された。著者の Crum 博士は北アメリカのセン類分類学の第一人者で、ミズゴケ類にも極めて明るい。本書は、メキシコ以北の北アメリカ大陸に産する 51 種のミズゴケ類についての詳細な記載、分布、変異等に関する論義、図説から成っている。文献は北アメリカの種類に直接ないしは間接に關係するものが多数かかげられていて、ミズゴケ類の研究には極めて便利である。日本産の種類に深い關係をもつものも多数あり、日本のミズゴケ類を調べる上で、見落せない文献である。
(井上 浩)